

Application No. 09/438,266
Response to Office Action

Customer No. 01933

Listing of Claims:

1. (Currently Amended) A color reproduction system
comprising:

color image input means for sensing an object;

color estimation means for calculating tristimulus values
5 from a color image signal obtained by ~~said the~~ color image input
means; and

color image output means for outputting a color image signal
based on a color represented by the tristimulus values obtained
by ~~said the~~ color estimation means,

10 ~~said the~~ color estimation means including:

illumination light measuring means for measuring tristimulus
values of observation illumination light,

virtual illumination light spectrum calculation means for
calculating a virtual illumination light spectrum that provides
15 tristimulus values equal to the tristimulus values of the
observation illumination light which are obtained by ~~said the~~
illumination light measuring means, and

tristimulus value calculation means for calculating
tristimulus values of the object under the virtual illumination
20 light spectrum from the color image signal.

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2. (Currently Amended) A system according to claim 1, wherein ~~said~~ the virtual illumination light spectrum calculation means calculates a spectrum from a linear combination of predetermined illumination light spectrum basis functions.

3. (Currently Amended) A system according to claim 1, wherein ~~said~~ the virtual illumination light spectrum calculation means calculates a spectrum satisfying the relation that linear conversion of a product of a spectral sensitivity of ~~said~~ the color image input means and a photographing illumination light spectrum is a product of a color matching function and the virtual illumination light spectrum.

4. (Currently Amended) A system according to claim 1, wherein ~~said~~ the color image input means and ~~said~~ the illumination light measuring means are positioned under different kinds of illumination light.

Claim 5 (Canceled).

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6. (Currently Amended) A color reproduction system which can sense a predetermined object as a color image, perform color correction of the sensed color image, and perform data transfer through a line, comprising:

5 a color camera for sensing the object under photographing illumination light;

a simplified spectrophotometer for measuring a spectrum of the photographing illumination light;

10 an illumination light colorimeter for measuring tristimulus values of observation illumination light on an object observation side, and transferring the tristimulus value data of the observation illumination light to a color correction device through a line;

15 a color correction device for calculating tristimulus values of the object under the virtual illumination light spectrum generated on the basis of the transferred tristimulus values of the observation illumination light, and converting the tristimulus values into a monitor signal by using monitor profile data; and

20 a monitor for displaying a color image including an object image color-corrected by ~~said~~ the color correction device.

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7. (Currently Amended) A color reproduction system
according to claim 6, which can sense a predetermined object as a
color image, perform color correction of the sensed color image,
and perform data transfer through a line, comprising:

5 a color camera for sensing the object under photographing
illumination light;

a simplified spectrophotometer for measuring a spectrum of
the photographing illumination light;

an illumination light colorimeter for measuring tristimulus
10 values of observation illumination light on an object observation
side, and transferring the tristimulus value data of the
observation illumination light to a color correction device
through a line;

a color correction device for calculating tristimulus values
15 of the object under the virtual illumination light spectrum
generated on the basis of the transferred tristimulus values of
the observation illumination light, and converting the
tristimulus values into a monitor signal by using monitor profile
data; and

20 a monitor for displaying a color image including an object
image color-corrected by the color correction device;

 wherein said the color correction device comprises:

 a storage device storing a basis function ρ of a
daylight spectrum, monitor profile data MTP, color matching

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25 function data CMF, and spectral sensitivity data h of ~~said~~ the
RGB color camera in advance;

a virtual illumination light spectrum calculator for
calculating virtual illumination light spectrum data OS from
tristimulus values XYZ of observation illumination light
30 measured by ~~said~~ the illumination light colorimeter and the basis
function ρ from ~~said~~ the storage device;

a spectral reflectance calculator for calculating
spectral reflectance data f of the object from object
characteristic data σ and the spectral sensitivity data h from
35 ~~said~~ the storage device, RGB image data CRGB input from ~~said~~ the
RGB color camera, and a photographing illumination light spectrum
from a simplified spectrophotometer;

a tristimulus value calculator for calculating
tristimulus value data $OXYZ$ of the object from the color matching
40 function data CMF from ~~said~~ the storage device, the virtual
illumination light spectrum data OS from ~~said~~ the virtual
illumination light spectrum calculator, and the spectral
reflectance data f from ~~said~~ the spectral reflectance
calculator; and

45 an output signal calculator for calculating the RGB
image data CRGB serving as the monitor signal from the monitor
profile data MTP from ~~said~~ the storage device and the tristimulus
value data $OXYZ$ from ~~said~~ the tristimulus value calculator.

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8. (Currently Amended) A color reproduction system
according to claim 6, which can sense a predetermined object as a
color image, perform color correction of the sensed color image,
and perform data transfer through a line, comprising:

5 a color camera for sensing the object under photographing
illumination light;

a simplified spectrophotometer for measuring a spectrum of
the photographing illumination light;

10 an illumination light colorimeter for measuring tristimulus
values of observation illumination light on an object observation
side, and transferring the tristimulus value data of the
observation illumination light to a color correction device
through a line;

15 a color correction device for calculating tristimulus values
of the object under the virtual illumination light spectrum
generated on the basis of the transferred tristimulus values of
the observation illumination light, and converting the
tristimulus values into a monitor signal by using monitor profile
data; and

20 a monitor for displaying a color image including an object
image color-corrected by the color correction device;

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wherein ~~said the~~ the color correction device comprises:

a storage device storing the monitor profile data MTP,
the a color matching function data CMF, and ~~the a~~ a spectral
25 sensitivity data h of ~~said the~~ the RGB color camera in advance;

a virtual illumination light spectrum calculator for
calculating a conversion matrix MTX from the tristimulus values
IXYZ of the observation illumination light measured by ~~said the~~ the
illumination light measuring device, the monitor profile data MTP
30 from ~~said the~~ the storage device, and the color matching function
data CMF;

a tristimulus value calculator for calculating the
tristimulus value data OXYZ of the object from the conversion
matrix MTX from ~~said the~~ the virtual illumination light spectrum
35 calculator and the RGB image data CRGB input from ~~said the~~ the RGB
color camera; and

an output signal calculator for calculating RGB image
data CRGB serving as the monitor signal from the monitor profile
data MTP from ~~said the~~ the storage device and the tristimulus value
40 data OXYZ from ~~said the~~ the tristimulus value calculator.

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9. (Currently Amended) A color reproduction system
~~according to claim 6, which can sense a predetermined object as a~~
color image, perform color correction of the sensed color image,
and perform data transfer through a line, comprising:

5 a color camera for sensing the object under photographing
illumination light;

a simplified spectrophotometer for measuring a spectrum of
the photographing illumination light;

10 an illumination light colorimeter for measuring tristimulus
values of observation illumination light on an object observation
side, and transferring the tristimulus value data of the
observation illumination light to a color correction device
through a line;

15 a color correction device for calculating tristimulus values
of the object under the virtual illumination light spectrum
generated on the basis of the transferred tristimulus values of
the observation illumination light, and converting the
tristimulus values into a monitor signal by using monitor profile
data; and

20 a monitor for displaying a color image including an object
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wherein ~~said~~ the color correction device comprises:

a storage device storing object characteristic data σ ,
monitor profile data MTP, color matching function data CMF,
25 standard illumination light spectrum data SS, tristimulus values
JXYZ of standard illumination light, and spectral sensitivity
data h of ~~said~~ the RGB color camera;

a spectral reflectance calculator for calculating
spectral reflectance data f of the object from the object
30 characteristic data σ and spectral sensitivity data h from ~~said~~
the storage device, RGB image data CRGB input from ~~said~~ the RGB
color camera, and photographing illumination light spectrum data
MS from ~~said~~ the simplified spectrophotometer;

a tristimulus value calculator for calculating
35 tristimulus values SXYZ of the object under standard illumination
light from the spectral reflectance data f from ~~said~~ the spectral
reflectance calculator and the color matching function data CMF
and standard illumination light spectrum data SS from ~~said~~ the
storage device;

40 a corresponding color calculator for calculating
tristimulus values CXYZ of a corresponding color of ~~said~~ the
object from the tristimulus values SXYZ from ~~said~~ the tristimulus
value calculator, tristimulus values JXYZ of standard
illumination light from ~~said~~ the storage device, and tristimulus

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45 values IXYZ of observation illumination light from ~~said~~ the
illumination light colorimeter; and
an output signal calculator for calculating RGB image
data CRGB serving as the monitor signal from the tristimulus
values CXYZ from ~~said~~ the corresponding color calculator and the
50 monitor profile data MTP from ~~said~~ the storage device.

Claims 10 and 11 (Canceled).

12. (Currently Amended) A system according to claim 6,
wherein ~~said~~ the system comprises a plurality of color chips,
each having a known spectral reflectance, and a digital camera
having a known spectral sensitivity ~~in place of said illumination~~
5 ~~light colorimeter~~, and

~~said~~ wherein the color chips are arranged near ~~said~~ the
monitor and reflected light of observation illumination light
reflected by each color chip is photographed by ~~said~~ the digital
camera, thereby calculating tristimulus values of the observation
10 illumination light from a photographing signal of each color chip
which is obtained by photographing, spectral sensitivity data of
~~said~~ the digital camera, spectral reflectance data of each color
chip, and color matching data.